

23 June 1993



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***Central Eurasia:  
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## Central Eurasia: Earth Sciences

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**Soviet-Japanese Seismic Experiment in the Sea of Japan. Preliminary Results**

937N0077A Novosibirsk TIKHOKEANSKAYA GEOLOGIYA in Russian No 5, Sep-Oct 92 pp 138-147

[Article by B. Ya. Karp, N. Hirata, H. Kinoshata, K. Suyehiro, V. V. Zdorovenin, and V. N. Karnaukh; Pacific Oceanological Institute of the Far Eastern Division of the USSR Academy of Sciences and Tokyo University; UDC 550.834]

[Abstract] In the summer and fall of 1990, the Pacific Oceanological Institute of the Far Eastern Department of the USSR Academy of Sciences and Tokyo University undertook a joint seismic experiment in the Japanese, or Central, Basin of the Sea of Japan to determine its seismic structure and crust thickness. The distribution of sedimentary thickness and the relief of the basin's acoustical basement were also studied. The experiment entailed two variations of the refracted-wave method of deep-sea seismic exploration along two mutually perpendicular profiles with 26 seismic detectors arrayed in a wide V on the ocean bottom. The first variation entailed the use of a transmitting vessel, which set off large (130- to 400-kg) charges of condensed explosives, and a receiving vessel. The second variation employed sonobuoys, 25-kg charges, and pneumatic wave sources. The reflected-wave method of seismic profiling using a multi-channel recording system and areal surveying with a single-channel seismic profiler were also used to study the same profiles. It was found that acoustical basement of the larger part of the basin is characterized by a rugged relief at depths of 5.8 to 6.6 fathoms from the ocean's surface. The eastern part of the basin has a region of basement subsidence more than 6.8 fathoms in depth. A preliminary analysis of some of the seismic data revealed that the crust is a sedimentary layer (P-wave speed of 1.6 to 3.5 km/sec) with 2B and 2C layering (P-wave speed 4.5 to 4.8 km/sec). P-wave speed at the Moho discontinuity was 8.0 to 8.2 km/sec. The crust is 8.0 to 8.5 km thick, measuring from the surface of the ocean bottom. Figures 6; references 27: 9 Russian, 18 Western.

**An Experimental Hydrogeological Analysis of the Consequences of Major Accidents at Nuclear Power Plants (Applicable to Facilities Currently in the Design Phase). Part I. Validation of Predictive Models**

937N0078A Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 6, Nov-Dec 92 pp 92-102

[Article by V. G. Rumynin, P. K. Konosavskiy, and S. A. Pereverzeva; St. Petersburg Mining Institute; UDC 556.3]

[Abstract] The possible effects of hypothetical nuclear power plant accidents on subsurface groundwater are evaluated. The first section of the article is devoted to the description of three types of highly unlikely but potentially catastrophic accidents. The first scenario is

based on the rupture of the main circulatory piping in the primary loop, which would result in a loss of coolant. The second accident scenario is associated with a power failure, the development of either a small or a large leak, and the failure of back-up diesel power generators to kick in. The third scenario, which would result from the occurrence of one or both of the first two scenarios, presumes a large-scale atmospheric release and subsequent fallout of radioactive contamination. The second section of the article describes the specific hydrogeological features of the area to be occupied by a Kola nuclear power plant installation that is currently in the design phase, and the theoretical interaction of these features with the nuclear contamination that would be released in the event of the occurrence of one of the accident scenarios. The final part of the article provides an overview of the hydrogeological research required to validate the parameters of the mathematical models that will be used to predict the extent of groundwater contamination in the event of a major accident. Figures 8, tables 2; references 18: 15 Russian, 3 Western.

**Geological Prospects of Creating a Raw Materials Base for Titanium Production in Kazakhstan**

937N0079A Alma-Ata IZVESTIYA AKADEMII NAUK RESPUBLIKI KAZAKHSTAN: SERIYA GEOLOGICHESKAYA in Russian No 6, Nov-Dec 92 pp 3-8

[Article by A. Ye. Bekmukhametov and A. R. Niyazov, the Institute of Geological Sciences imeni K. I. Satpayev and the Kazakhstan Academy of Sciences; UDC 553.490.04(574)]

[Abstract] The problem of creating Kazakhstan's own long-term source of low-cost, high-quality raw materials for titanium production was examined. Of all the types of titanium mineralization known to exist in Kazakhstan, only the Kundybay-type ore found in the titanium-bearing formations exposed by the wind erosion of ancient metamorphic rock in northern Kazakhstan is suitable for industrial exploitation. This ore has a number of advantages, including the presence of a number of medium to large deposits of both low-chromium ilmenite and leucoxine-rutile titanium concentrations that are far enough apart to be mined independently. The ore is of high quality, and the ore-bearing formations are easily workable. Another plus from an environmental standpoint is that the ore-concentration tailings make excellent raw materials for the ceramics and construction industries. Therefore, it was recommended that these ore deposits be exploited by developing a process for removing the chromium from the ilmenite concentrations and suitable processes for pre-concentrating the rutile ores. It was also recommended that this type of titanium-bearing formation be studied more thoroughly from a geological as well as an industrial standpoint. Figures 2; references 8: Russian.

**Possibility of Obtaining Information on Climate Parameters From American Operational Satellite Data**

*937N0070 Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 7, Jul 92 pp 744-750*

[Article by K. Ya. Kondratyev, St. Petersburg Scientific Research Institute, Center for Ecological Safety]

[Abstract] This survey article lists equipment found on US NOAA satellites which may be used for climate

research, in particular, radiometers which take measurements in various regions of the spectrum (infrared, ultraviolet). The importance of long-term, consistent series of data in detecting climate trends is discussed. Maximum permissible limits on error in determining atmospheric properties are outlined. Research which is being conducted for the stratosphere, troposphere, land surface, and ocean is described. A table lists which parameters may be measured from satellites and which instruments measure each of these parameters. Plans for future expansion of studies are described. Table 1; references 10: 9 Russian, 1 Western.

**Formation of the Vertical Component of Acoustic Power Flux in Long-Distance Signal Propagation**  
*937N0072A Moscow DOKLADY AKADEMII NAUK in Russian Vol 329, No 3, Mar 93 pp 360-362*

[Article by V. A. Gordienko, B. I. Goncharenko, and Academician V. I. Ilichev, Moscow State University and Pacific-Ocean Oceanological Institute, under the rubric "Oceanography"; UDC 551.463.21]

[Abstract] In the case of acoustic sensing in deep seas using a relatively shallow (30-100 m) pressure-gradient receiver [PGR] system, the position of the acoustic source above or below a certain critical depth (15-20 m) can be judged by the sign of the vertical component of the received acoustic power flux; i.e., by whether the flux approaches from above or below. The same is true in shallow seas, except in the case of extensive water bodies 25-40 m deep, when a secondary wave propagating along the water-soil interface interferes with reception. Data were gathered for long-distance paths in deep areas of the northwest Pacific Ocean, the equatorial Pacific and Indian Oceans, and the Mediterranean Sea, as well as in shallow continental-shelf zones of the Pacific Ocean and the Black Sea. Various receiving systems were used: towed combination systems consisting of a sound-pressure receiver and a three-component PGR, drifting radio-relay bottom stations, and 3- to 6-element linear PGR antennas. Formulas for acoustic-field potentials are derived for a stratified ocean with layers of different indices of refraction and for the water-air interface. References: 5 Russian.

**Interannual Variability of Thermohaline Fields in Tropical Atlantic**

*937N0073A Moscow OKEANOLOGIYA in Russian Vol 33 No 1, Feb 93 pp 32-37*

[Article by G. F. Dzhiganshin and A. B. Polonskiy, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 551.435(261)]

[Abstract] An analysis of maps of the distribution of residual standard deviations, histograms of the frequencies of recurrence of interannual anomalies and spectral computations indicates that within the limits of the Tropical Atlantic there are several regions of strong interannual temperature and salinity variations. Archival data for 1911-1989 are used in describing macroscale anomalies of thermohaline characteristics in the Tropical Atlantic. In the West African upwelling, for example, interannual temperature variations with characteristic values about 0.5-0.6°C and maximum values about 5°C are observed. With respect to amplitude, variations with a period about 5-7 years predominate. In the thermocline the range of characteristic temperature deviations from the climatic norm are far broader than in the surface layers (0.2-2.0°C). The maximum temperature anomalies in the western and eastern parts of the Tropical Atlantic attain 6 and 7°C respectively. The

characteristic period of interannual temperature fluctuations near the equator is 2.5-3 years. With northward movement from the equator the period of the strongest interannual fluctuations increases to 4-5 years at 7.5°N and to 10 years at 12.5°N. The greatest interannual salinity deviations from the climatic norm are observed in the coastal regions of the equatorial zone. The strongest surface salinity variations occur within a period 5-7 years. These and other interannual variations of thermohaline characteristics in the Tropical Atlantic are evidently caused to a considerable degree by interannual variability in an ocean-atmosphere system of the El Nino-Southern Oscillations type and the similar spectral composition of interannual variations of thermohaline fields in the tropical zone of the Pacific and Atlantic Oceans. Figures 3; references: 7 Western.

**Structure and Variability of Acoustic Characteristics of Waters in Regions of Antarctic Ocean Bottom Rises**

*937N0073B Moscow OKEANOLOGIYA in Russian Vol 33 No 1, Feb 93 pp 44-48*

[Article by N. P. Bulgakov and P. D. Lomakin, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 551.465]

[Abstract] During the warm half-year in Antarctic Ocean waters there is a thermal subsurface sound channel caused by a cold intermediate layer. No information on this phenomenon has been reported in the literature. This stable (subsurface) sound channel is beneath the upper quasihomogeneous layer at a depth 100-400 m and its width varies from several tens to 100-200 m. In the neighborhood of bottom rises of the Atlantic and Indian Ocean sectors of the Antarctic region (Ships Seamount, Ob, Lena, Shchuch'ya, Novaya Banks) there is periodic destruction and restoration of the subsurface sound channel. This is confirmed by data from about 800 stations occupied in this region during the last 20 years. One of the possible factors responsible for this phenomenon is a topographic eddy effect, localized over the top of a bottom rise, whose intensity is directly dependent on the velocity of the Antarctic Circumpolar Current. The characteristics of sound propagation in the neighborhood of bottom rises are examined in a ray approximation, as are various other characteristics of mesoscale variability of the hydroacoustic structure. A change in the structure of the speed of sound field exerts a considerable influence on the trajectory of the acoustic rays along paths intersecting a bottom rise. The channel character of sound propagation is replaced by an antichannel character of sound propagation and vice versa. Figures 4; references 5: 3 Russian, 2 Western.

**Dispersion Relation and Phase Velocity of Surface Waves in Sea of Finite Depth**

*937N0073C Moscow OKEANOLOGIYA in Russian Vol 33 No 1, Feb 93 pp 57-61*

[Article by V. A. Kalmykov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 466.531]

[Abstract] For a slightly nonlinear steady train of waves all the harmonics move at the same velocity, with the velocity of the fundamental wave component, and do not satisfy the linear dispersion relation (the free linear and related nonlinear harmonics have a different behavior and the problem arises of the influence of the nonlinearity and width of the wave system band on the behavior of the wave components). An effort was made to clarify this problem. The Zakharov equation was used in computing the phase velocities and dispersion relations for different depths. The case of the one-dimensional field of surface gravity waves without wind and currents is investigated. JONSWAP spectra of different bandwidth and steepness were used in the computations. Figures 1, 2 and 3 present the results of computations of frequencies and phase velocities at different depths and a comparison with experimental data is given. The influence of nonlinearity of surface waves on the dispersion relation and phase velocity in deep water also is demonstrated by a comparison of computed and experimental data. With allowance for depth and with its decrease this influence increases. It also increases with a decrease in spectral bandwidth. Expansions of the frequency spectrum of the waves during their shoreward propagation must be expected since distortions of the dispersion relation occur least of all for a broad spectrum. Figures 3; references 7: 5 Russian, 2 Western.

#### **Probable Mechanisms of Formation of Variability of Sound Backscattering in Region of Tropical Atlantic With Coordinates 2°S- 10°N, 38°W-49°W**

937N0073D Moscow OKEANOLOGIYA in Russian  
Vol 33 No 1, Feb 93 pp 69-72

[Article by V. M. Kobzar, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 551.463.262:551.46.09]

[Abstract] Remote acoustic soundings of the ocean surface layer from aboard the Akademik Vernadskiy off the coast of Brazil, making it possible to detect nonuniformities in the sound backscattering level at different scales, were analyzed. Ninety-eight soundings, made along meridional runs 30 miles apart with a distance between runs about 180 miles, were generalized. Measurements were made in the surface layer 0-200 m at different times of day. On the assumption of a biological nature of the scatterers, on the basis of the dependence of photosynthesis intensity on the concentration of biogens it is shown that nonuniformities in their distribution may be responsible for excesses in the sound backscattering level by a factor not greater than 1.8. This is considerably less than the real excess of the maximum levels above the minimum levels by a factor of 5. An explanation for this discrepancy was sought. The upwelling of deep waters in cyclonic eddies with vertical velocities about  $10^{-2}$  cm/s can be considered the probable mechanism of arrival of biogenous elements responsible for the formation of the observed very strong horizontal nonuniformities in the distribution of the

plankton concentration in the surface layer of the investigated region in the Tropical Atlantic. Such nonuniformities, detected in the process of remote acoustic sounding through nonuniformity of the sound backscattering level, will help in ascertaining the location of strong eddy systems determining surface circulation in the region. Figure 1; references 9: 8 Russian, 1 Western.

#### **Nonlinear Effects Accompanying Propagation of Packets of Internal Waves in Ocean**

937N0080A Sevastopol MORSKOY  
GIDROFIZICHESKIY ZHURNAL in Russian No 6,  
Nov-Dec 92 pp 3-21

[Article by A. A. Belobrov, N. A. Panteleyev and A. A. Slepyshev, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 551.466.8]

[Abstract] The mechanisms of generation of the mean fields of density and current velocity in a medium with a vertical current velocity shear, caused by the nonlinearity of packets of internal waves, are analyzed. The full range of nonlinear effects accompanying the propagation of quasimonochromatic internal waves are examined in detail. The modulation instability of such internal waves is investigated with allowance for the Earth's rotation and a nonlinear Schrodinger equation for evolution of the envelope is derived. Inertial-gravity internal waves for which the time scale of the envelope is considerably greater than the inertial period induce corrections, nonoscillating at the considered time scale, to the vertical distribution of mean density and current velocity which are proportional to the square of the momentary wave amplitude. A current induced by a Euler wave is directed along the direction of wave propagation and precisely compensates for the Stokes drift. Examples of some accompanying effects are discussed. For example, in the neighborhood of resonance of group velocity of the packet and the phase velocity of a low-frequency wave of a higher mode there is a change in the nature of the wave of deformation of the upper and lower boundaries of the thermocline (expansion of the thermocline is replaced by compression). Figures 7; references 14: 11 Russian, 3 Western.

#### **Experimental Determination of Small-Scale Turbulence Coefficients in Sea Surface Layer**

937N0080B Sevastopol MORSKOY  
GIDROFIZICHESKIY ZHURNAL in Russian No 6,  
Nov-Dec 92 pp 54-61

[Article by A. M. Chukharev, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 551.465.15]

[Abstract] The results of a large number of experiments for investigating diffusion of fluorescent dyes are given. Although many studies of this type have been described, most of them have dealt with turbulent diffusion processes at scales from tens of meters to several kilometers;

few studies have been devoted to the initial stage in propagation of an impurity (tens of centimeters to several meters). Turbulent diffusion at these scales was determined using a method based on an underwater photographic survey of the dye jet with subsequent processing of the negatives using a microphotometer. The factors exerting an influence on the experimental results are discussed in detail; the sources of error are outlined and the ways to avoid these errors are indicated. A small (about 20%) excess of the vertical coefficients over the horizontal coefficients was discovered at scales of such events 0.3-1 m. Empirical expressions are derived giving the dependence between the vertical coefficient of turbulent diffusion and the parameters of surface waves. These expressions make it possible to estimate the vertical coefficient of small-scale turbulent diffusion at different depths and with waves of different height up to the appearance of collapsing waves, but when the latter (being a more powerful mechanism of turbulence generation) are present the proposed computation method can no longer be used. Figures 3; references 13: 12 Russian, 1 Western.

### El Nino During 1991-1992 and Its Manifestations in Tropical Atlantic

937N0080C Sevastopol MORSKOY  
GIDROFIZICHESKIY ZHURNAL in Russian No 6,  
Nov-Dec 92 pp 62-70

[Article by Ye. N. Voskresenskaya, A. A. Zelenko and A. B. Polonskiy, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; Russian Hydrometeorological Center, Moscow; UDC 551.465]

[Abstract] The anomalous conditions observed in the tropical zone of the Pacific and Atlantic Oceans during the period of development of El Nino (EN) during 1991-1992 are described. The current El Nino has been characterized by a number of specific features in the behavior of anomalies of the Southern Oscillation (SO) index and water surface temperature in the equatorial zone of the Pacific Ocean. This also was accompanied by warming of the eastern part of the Tropical Atlantic. The current EN-SO event began in the spring of 1991. The distinctive features of EN-91/92 include the following. The SO index during the summer months of 1991 was less in absolute value than in the spring and it attained its 1991 minimum in December. Prior to October 1991 there were virtually no surface temperature anomalies along the western coast of South America. The principal warm anomaly was formed in the surface layer in the eastern part of the equatorial zone of the Pacific Ocean between 90 and 130°W in May 1991 and moved in a westerly direction at a velocity about 25 cm/s, intensifying to August-September and increasing in size until the end of the year. Simultaneously with positive anomalies in the Pacific Ocean, warm anomalies began to form in the Tropical Atlantic which attained maximum development two or three months sooner than in the Pacific Ocean, in May-June 1991. The absolute level of water surface temperature anomalies during the period

of their maximum development in the Tropical Atlantic was close to the level of Pacific Ocean anomalies (about 3 and 4°C respectively). Figures 6; references 16: 7 Russian, 9 Western.

### Features of Magnetization of Submarine Oceanic Rocks

937N0019A Moscow FIZIKA ZEMLI in Russian No 9,  
Sep 92 pp 92-99

[Article by V. I. Trukhin, V. Yu. Safroshkin and A. G. Gorshkov, Physics Faculty, Moscow State University; Oceanology Institute imeni P. P. Shirshov, Russian Academy of Sciences; UDC 550.382.3]

[Abstract] The magnetic properties and natural remanent magnetization of the principal types of rocks of the second layer of the oceanic crust were investigated: tholeiitic and transitional basalts, as well as serpentinites, indicated that the more ancient the rocks, the more complex is their  $I_n$  composition. The chemical processes transpiring during the course of geologic time and dependent on the specific geologic conditions of rock bedding result in a substantial change in  $I_n$ , including due to internal interactions in the complex ferrimagnetic fraction. This means that  $I_n$  in chemically modified rocks does not reflect strength of the ancient geomagnetic field. Due to internal magnetic interactions there may be not only a decrease in the  $I_n$  value, but also a change in its direction if the secondary component of  $I_n$  directed antiparallel to the primary component exceeds it in value. In this case an  $I_n$  self-inversion will occur. In the anomalous geomagnetic field of the ocean there also is a part of the field not caused by rock magnetization in the ancient geomagnetic field, but by magnetic reversal due to internal interactions in the complex ferrimagnetic fraction. Allowance for this "nonfield" or nonlinear part of  $I_n$  is completely necessary in the interpretation of oceanic anomalies. Figures 7; references 11: 6 Russian, 5 Western.

### Salt Fingers in Quasistationary State

937N0020D Moscow IZVESTIYA AKADEMII NAUK:  
FIZIKA ATMOSFERY I OKEANA in Russian Vol 28  
No 9, Sep 92 pp 988-997

[Article by A. Ye. Pogrebnoy, Marine Hydrophysics Institute, Ukrainian Academy of Sciences; UDC 551.465.1]

[Abstract] Theoretical research on salt fingers is very difficult because the full system of equations of motion, supplemented by the equation of state and boundary conditions, is subdefinite. The results of laboratory experiments on the convection of salt fingers in interlayers separating quasihomogeneous layers are reviewed. However, the nature of the qualitative difference in the consequences of the effect exerted on salt fingers by velocity shear fields with different time characteristics

for the time being remains unclear. Accordingly, a quasistationary model of salt fingers in an interlayer separating mixed layers was constructed. The consequences of the influence exerted on the fingers by turbulence and stationary velocity shears are analyzed for closing the system of equations. The derived analytic expressions are consistent with known laboratory data for heat-salt and salt-sugar systems. An example of computations of salt finger parameters under stipulated external conditions is given. In contrast to the E. Kunze model (J. MARINE RES., Vol 45, pp 533-556, 1987), the proposed model describes the quasistationary state of salt fingers. Its equations were derived without invoking any similarity or dimensionality considerations. The principal advantage of this model in comparison with those proposed earlier is that it describes not only the limiting case (heat-salt model), but also is applicable for such systems as binary (salt-sugar) solutions. The model is applicable for describing series of long-lived (quasistationary) high-gradient interlayers of salt fingers with the vertical scales commonly occurring in the ocean. Figures 4; references: 17 Russian.

#### Instrumental Correction of Images Distorted by Scattering Medium

937N0054C Tomsk *OPTIKA ATMOSFERY I OKEANA*  
in Russian Vol 5 No 8, Aug 92 pp 888-892

[Article by A. N. Alekseyev, V. V. Belov, B. D. Borisov  
and N. V. Molchunov, Atmospheric Optics Institute,

Siberian Department, Russian Academy of Sciences,  
Tomsk; UDC 551.521+535.561]

[Abstract] Some results of use of an instrumental method for the correction of images distorted by scattering media are examined. The correction is based on the suppression of the scattered and amplification of the unscattered signal component. The results of laboratory experiments for observing objects through scattering media with the use of a newly developed electronic image correction block are given. A block diagram of the electronic system is given with 11 components identified. The results of instrumental correction and numerical filtering of images distorted by a scattering medium are compared. The initial object was a layout of three bright triangles with a dark spot at the center. Three different situations were studied: 1) a layer of increased turbidity borders on the object; 2) a layer of increased turbidity is situated between the object and the observer; 3) a layer of increased turbidity is situated near the observer. It was found that the inclusion of a contrast correction device in the registry channel exerts a positive influence on the formed image in all the optical-geometric observation situations, each of which is examined in detail. In addition, the filtering of the distorted images using the Tikhonov method and point scattering functions computed by the Monte Carlo method was carried out for each of the three mentioned situations and the results are compared. Figures 6; references: 11 Russian.

**Efficiency of Adaptive Correction for Random Tilts of Wave Front of Laser Beams Propagating Through Turbulent Atmosphere**

937N0068A Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 7, Jul 92 pp 708-715

[Article by G. M. Samelson, Leningrad Electrotechnical Communications Institute; UDC 621.375.826:535.3]

[Abstract] The efficiency of a phase-conjugate system for correcting the direction of laser beam propagation was analyzed. It is assumed that the correction is made by measuring, within the transmitting aperture, the random tilts of the wave field front for a wave generated by a point reference source under the conditions prevailing in a turbulent atmosphere. Such a correction is simplest with respect to technical realization. Applicability of the additivity principle also is assumed, even under conditions of radiation propagation along extended paths. The wave front tilts, to a lesser degree than small-scale phase fluctuations, also are sensitive to the operation of other factors reducing correction efficiency. The selected efficiency indices, an increase in the mean intensity of radiation and the degree of suppression of fluctuations on the beam axis in the reception plane, are analyzed. On the assumption of the virtual equivalence of the correction of tilts and the replication of random displacements of the energy center of gravity of the laser beam, estimates are made of the relative contribution of the latter to the decrease in mean intensity of collimated beams with a Fresnel number on the order of unity. Figures 2; references 18: 9 Russian, 9 Western.

**Probability Density of Saturated Fluctuations in Intensity of Optical Wave in Turbulent Atmosphere**

937N0068B Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 7, Jul 92 pp 716-719

[Article by G. Ya. Patrushev and O. A. Rubtsova, Atmospheric Optics Institute, Siberian Department, Russian Academy of Sciences, Tomsk; UDC 621.373]

[Abstract] Modern theory of propagation of optical waves in a turbulent atmosphere, based on a parabolic approximation of the wave equation, fails to give a full description of the probability density of intensity fluctuations as a function of conditions even in the case of free propagation, leaving many questions unanswered. Accordingly, model probability densities were compared with experimental data for saturated intensity fluctuations of an optical wave in a turbulent atmosphere. It was found that for a plane wave in the region of saturated intensity fluctuations the experimental data definitely indicate deviations from a lognormal distribution. These deviations are such that the histograms approach a K-distribution. The tendency to a K-distribution has an asymptotic character. This is true because the formula used, corresponding to a model of multiray propagation, nevertheless assumes a nondependence of the phase fluctuations of the partial waves (rays), whereas in the

turbulent atmosphere fluctuations of the phase difference of optical waves are correlated at the distance of the external turbulence scale in which a sufficiently great number of rays fits. A K-distribution must therefore be regarded as an asymptotic approximation of the probability density of saturated intensity fluctuations. Figures 2; references 9: 7 Russian, 2 Western.

**Possibility of Determining Microphysical Parameters of Noctilucent and Mesospheric Clouds Using Data From Remote Twilight Sounding From Space**

937N0068C Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 7, Jul 92 pp 734-738

[Article by A. Pikhl and R. Ryym, Astrophysics and Atmospheric Physics Institute, Estonian Academy of Sciences, Tyravere; UDC 551.501]

[Abstract] The microphysical parameters of noctilucent and mesospheric cloud particles (mean radius and standard deviation of the distribution function of scatterers) were determined using data from remote sounding of the horizon from space under twilight conditions. It was found that the optimum measurable parameter is the color index. The simultaneous measurement of two color indices makes it possible to estimate the radius and dispersion of particles. In the range of small and medium particles the color index is more sensitive to variations of the half-width of the distribution function and is relatively slightly dependent on the mean radius of the scatterers. In planning a twilight sounding experiment it must be taken into account that the optical thicknesses of the paths are quite dependent on both the wavelength and on the azimuth of the line of sight and therefore there are certain admissible angles of solar depression in the UV, visible and IR regions. In the processing of the collected data there must be careful allowance for the extinction of solar rays in the lower atmosphere, but in the IR region refraction must be taken into account. The use of two color index values, one in the UV and in the visible region, and the other in the IR region, is most effective for determining the key parameters. The use of the degree of polarization for determining the distribution parameters under twilight conditions is infeasible for two reasons: the isolines of the degree of polarization of the color index on a large part of the (r,d) plane are parallel, as a result of which there must be a simultaneous determination of both distribution function parameters, and the qualitative measurement of polarization from space is difficult because the values of the degree of polarization in the solar aureole region are very small. Figures 4; references 7: 5 Russian, 2 Western.

**Influence of Orientation of Aspherical Scattering Particles on Atmospheric Transmission Coefficient**

937N0067A Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 3, Mar 92 pp 227-231

[Article by Yu. A. Lebedinskiy and K. G. Predko, Physics Institute, Belarus Academy of Sciences, Mogilev; UDC 551.521.3]

[Abstract] An approximate analytic algorithm for solving the transfer equation in a medium with elementary volume parameters dependent on the direction of incidence of the radiation and an evaluation of its accuracy were presented in an earlier article by the authors (IZV. AN SSSR: FAO, No 12, pp 1293-1299, 1986), which served as a basis for this further research. Applying this algorithm, a study was made of the behavior of the transmission coefficient of a scattering atmosphere with aspherical spatially oriented particles with allowance for the multiple scattering of radiation. Spheroids, whose shape can serve as an approximation of the shape of scattering particles of natural objects, were selected as a model for a qualitative description of the behavior of the atmospheric transmission coefficient. It was assumed that the particles are sufficiently large to have a definite orientation and that orientation is possible along the vertical axis. The geometric optics approximation is assumed to be correct in the case of scattering of radiation on such particles in the visible range. The extinction parameter is assumed to be proportional to the geometric section of the particles in the plane perpendicular to the direction of incidence. In such a formulation a solution is found for the problem in the case of slant incidence on a layer. The analysis is centered on the behavior of transmission as a function of the angle of incidence of radiation and medium parameters. Figures 3; references 12: 8 Russian, 4 Western.

### Large Spherical Adaptive Mirror

937N0067B Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 3, Mar 92 pp 257-262

[Article by V. I. Aksinin, Yu. V. Danchenko, Ye. A. Ivanova and S. A. Chetkin, General Physics Institute, Russian Academy of Sciences, Moscow; UDC 535.317]

[Abstract] The design of an adaptive mirror constructed in the form of a thin plate on an elastic base of highly porous spongy metal (HPSM) deformable by discrete actuators is described. The use of HPSM makes it possible to fabricate a large-diameter cooled mirror while maintaining a wide range of displacements of the working plate under the influence of actuators, to increase the frequency range of mirror operation, to improve stability and to enhance the quality of the reflecting surface. A model is proposed for computing the principal characteristics of the mirror. Within the framework of the model it was possible to determine the dimensionless parameters characterizing the form of the response functions and the range of displacements of the working plate under the influence of the actuators. The results of simulation with the described analytic model served as the basis for the designing of an active mirror with these specifications which is illustrated in Figure 1. Full details are given concerning mirror fabrication. In addition, a technology is described for obtaining a rigid contact between the mirror elements. It was checked in an experimental sample in the form of two copper plates between which a foam polyurethane filler was placed,

into which copper rods were inserted and whose ends were attached to the plates. Figures 4; references: 9 Russian.

### Statistical Model of Phase-Conjugate Adaptive Optical System With Allowance for Measurement Noise

937N0067C Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 3, Mar 92 pp 263-275

[Article by Ye. A. Ivanova, V. I. Kislov and S. A. Chetkin, General Physics Institute, Russian Academy of Sciences, Moscow; UDC 585.8]

[Abstract] Algorithms were written for control of a phase corrector (including a deformable mirror) of a phase-conjugate adaptive optical system (AOS) ensuring a minimum error in compensation for phase distortions (PD) with allowance for noise in measuring the PD and other phase corrector control effects. Also examined is the problem of retrieval with a minimum residual PD error using the results of measurements of the wave front sensor when measurement noise is present. Within the framework of a statistical approach, on the basis of variational and matrix calculus methods, algorithms are given for retrieving the wave front and compensating for field PD. In computations of the retrieved and compensating phase distributions use is made of a priori information on the statistical characteristics of the measured wave front, measurement noise and control errors. Controls for orthogonal modes of the Karunen-Loeve modes type ensuring the minimum error in compensating field PD with a stipulated number of modes and realized without error in approximation by a phase corrector with stipulated response functions were obtained and investigated. The results of computations of the residual errors in retrieval and compensation with a number of Hartman sensor measurement channels and a number of actuators 3, 7, 19 were found as a function of the measurement noise and the control error. Figures 4; references 12: 8 Russian, 4 Western.

### Influence of Wave-Covered Water Surface on Lidar Return Characteristics

937N0067D Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 3, Mar 92 pp 292-299

[Article by B. A. Kargin, G. M. Krekov and M. M. Krekova, Computer Center, Siberian Department, Russian Academy of Sciences, Novosibirsk; Atmospheric Optics Institute, Siberian Department, Russian Academy of Sciences, Tomsk; UDC 551.463.5:535.36]

[Abstract] The results of numerical simulation directed to investigation of the specifics of formation of the structure of the lidar return from a wave-covered surface are presented. The strength and power of the lidar return can be determined from solution of the nonstationary transfer equation within the framework of the initial and boundary conditions characteristic for operation of an

airborne monostatic lidar operating at a wavelength 0.5  $\mu\text{m}$  at a height 200 m above the water surface when making measurements when wind speeds are in the range  $1 \leq V \leq 7 \text{ m/s}$ . Estimates are made by the Monte Carlo method, making possible separate analysis of the dependence of the structure of the reflected signal on variations in the optical parameters of the medium and the geometric conditions of the experiment. A number of complicating factors and special cases are considered. The importance of using narrow apertures is stressed. A solution is found which gives estimates of the energy and strength of the radiation which is registered by the receiver. It was found that the nature of formation of the strength of the lidar return arriving from the water depths is essentially dependent on state of the sea surface. Work in this direction will be useful in the mapping of waters using optical criteria or stratification of optical properties with depth. Figures 6; references 14: 11 Russian, 3 Western.

#### Temporal Structure of Lidar Return in Pulsed Sounding of Wave-Covered Sea Surface

937N0067E Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 3, Mar 92 pp 300-308

[Article by M. L. Belov and V. M. Orlov, All-Union Marine Fisheries and Oceanography Scientific Research Institute, Moscow; UDC 551.501]

[Abstract] The temporal structure of the lidar return is investigated for the case of pulsed laser sounding of the sea surface. Expressions are derived for the lag, duration and mean strength of the lidar return registered by the lidar receiver in different modes when sounding a sea surface without foam and a partially foam-covered sea surface. The temporal structure of the lidar return from the sea surface is essentially dependent on the sounding scheme (monostatic or bistatic sounding, sounding to the nadir or slant sounding) and the relation between lidar radiation parameters (divergence angle, size of radiation spot on sea surface) and statistical characteristics of sea wind waves (rms slopes and heights of sea surface). The presence of foam on the sea surface exerts a strong influence on lidar return strength in all sounding system operating modes. The influence of the foam model on the lidar return is usually manifested only with a great

speed of the near-water wind and quite narrow laser beams (when the size of the spot on the sounded surface becomes comparable to the rms height of the waves). The influence of the atmosphere on the echo system is complexly dependent on the sounding system operating mode and the foam model. In the case of pulsed sounding atmospheric turbidity results in a sharp decrease in the influence of foam on the shape of the lidar return. This research essentially represents a continuation of a whole series of earlier articles by the authors on lidar sounding of the sea surface in the presence and absence of foam. Figures 5; references 22: 16 Russian, 6 Western.

#### Strength of Echo Signal in Atmospheric Sounding of Surface With Combined Scattering Phase Function

937N0067F Tomsk OPTIKA ATMOSFERY I OKEANA  
in Russian Vol 5 No 3, Mar 92 pp 309-312

[Article by M. L. Belov and V. M. Orlov, All-Union Marine Fisheries and Oceanography Scientific Research Institute, UDC 551.501]

[Abstract] In an earlier article (OPTIKA ATMOSFERY, Vol 4, No 10, pp 1066-1069, 1991) the authors examined laser sounding of a surface with a combined scattering phase function having quasispecular and diffuse components for the case of continuous laser irradiation. Continuing this line of research, a study was made of the characteristics of an atmospheric echo signal for the case of pulsed laser sounding of a surface with a similar combined scattering phase function. An expression is derived for the strength of the echo signal when sounding a surface having diffuse and quasispecular components in an optically dense aerosol atmosphere. The analysis revealed that the shape of the received echo pulse is essentially dependent on the relation of the quasispecular and diffuse components of the scattering phase function. This dependence is manifested more weakly for a more optically dense atmosphere, which is attributable to an increase in the effective angular width of the quasispecular component of the surface scattering phase function. The derived relations can be used in developing remote sensing laser systems and in an analysis of their operation. Figures 2; references: 5 Russian.

### Multisided Monitoring of Eruption of Pinatubo Volcano

937N0064A Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 93 pp 111-122

[Article by K. Ya. Kondratyev; UDC 528.8]

[Abstract] The initial results of multisided monitoring of the consequences of eruption of Pinatubo volcano are reviewed, largely on the basis of American data. This was the first experience in observing such a global phenomenon using satellite, aircraft, balloon and surface observations (a separate section is devoted to each type of observations). On this basis estimates are made of the climatic consequences of the eruption developing as a result of volcanically induced changes in the aerosol and gas composition of the stratosphere. It is stressed that the consequences of this event differ in many ways from the eruption of El Chichon and other volcanoes. An important consideration is that Pinatubo erupted in a year when in the course of quasi-biennial oscillations the principal manifestation of interannual variability of stratospheric temperature in the lower stratosphere is a change from W-E to E-W transport, whereas during the Agung and El Chichon eruptions the opposite situation prevailed. Moreover, whereas during these two events the sun moved from the equator toward the Tropic of Cancer, during the Pinatubo eruption the sun was situated far to the north and moved approximately southward. The transport of eruptive aerosol into the high latitudes of both hemispheres beginning in the autumn of 1991 therefore should result in a weakening of stratospheric warming in the tropical zone, but an intensification of global heating. The eruption was accompanied by the ejection of gases and dust to altitudes greater than 25 km, the greatest such occurrence in this century, and may have substantial climatic effects. These findings in part were used in evaluating the possibility of exceptionally cold winters in Moscow. References 20: 2 Russian, 18 Western.

### Principal Directions in Stabilization of Ecological Conditions in Russia and Their Expression in Directive Documents

937N0065A Novosibirsk GEOGRAFIYA PRIRODNYYE RESURSY in Russian No 1, Jan-Mar 93 pp 17-24

[Article by B. V. Poyarkov and G. A. Fomenko, Yaroslav State Pedagogic Institute; Yaroslav Oblast Committee for Ecology and Natural Resources; UDC 911.2:577.4]

[Abstract] The basic features and thrust of a national ecological policy are defined. There are four fundamental aspects of this policy: 1) There must be a guarantee of the fundamental ecological rights of man to a healthy environment; 2) Citizens have ecological obligations to meet, but they must be educated as to what these obligations are; 3) New economic-juridical attitudes must be instilled and developed for ensuring that individuals will enjoy a healthy environment; and 4) New

relationships must be established among different governmental levels and agencies for the effective implementation of this policy. The principles of national ecological policy and the legislation based on this policy will provide the juridical basis which will make possible the so-called ecologization of systems for control of the development of a region. The main objective of such a regional ecology program is the organization of management of environmental use during the period of transition to a market economy. All this must be done at the regional level, without intervention of central authorities, because each individual region has its own specific ecological-socioeconomic conditions. All aspects of the national policy and regional programs (including the ways in which they are to be financed) are discussed. Both are directed to solution of problems involved in the stabilization and subsequent improvement of ecological-socioeconomic conditions in the Russian Federation. References: 5 Russian.

### Research on Formation of Spotty Pattern of Radioactive Fallout Using Lagrangian-Eulerian Diffusion Model

937N0066A Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 12, Dec 92 pp 33-45

[Article by M. V. Buykov, Ye. K. Garger and N. N. Talerko, Kiev Radioecological Division, Tayfun Scientific Production Association; UDC 551.510.721.001.572(477.41)]

[Abstract] A Lagrangian-Eulerian diffusion model describing the propagation of an impurity from a point source under nonstationary meteorological conditions is described. The applicability of the model for distances up to 30 km from the source was investigated using data on discharges of SO<sub>2</sub> from thermal electric power plants. The formation of the southerly track of radioactive pollution by <sup>137</sup>Cs as a result of the Chernobyl accident was simulated. A substantial role of the diurnal variation of the parameters of the atmospheric boundary layer in the formation of a spotty pattern of radioactive fallout is demonstrated. The results of the computations are compared with both the results of measurements of the surface concentration of <sup>137</sup>Cs as of 1990 and with the results of daily measurements of the fallout of this radionuclide made in 1986. Taking into account the prevailing uncertainty in the values of the input parameters of the model, related to the estimated character of many source characteristics and the roughness of allowance for the diurnal variation of turbulent characteristics, it can be said that there is a qualitative agreement between the locations of the predicted and actual regions of increased surface concentration of radioactivity. The results reveal the importance of making allowance for the diurnal variability of turbulent characteristics of the atmospheric boundary layer when making computations of the transport of impurities for distances of hundreds or more kilometers for the purpose of evaluating the spotty pattern of pollution of the underlying surface. Figures 3; references 18: 14 Russian, 4 Western.

**Secular Changes in Times of Ice Appearance on Rivers and Their Relationship to Climatic Changes**

937N0066B Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 12, Dec 92 pp 71-79

[Article by B. M. Ginzburg, K. N. Polyakova and I. I. Soldatova, Hydrometeorological Scientific Research Center, Russian Federation; UDC 556.535.5:551.583.14(47+57)]

[Abstract] Observational data on the times of appearance of floating ice on the rivers of Russia, Belarus and the Ukraine for the period 1881-1990 were analyzed to ascertain their possible climatic implications. A maximum linear trend of these times to "late" for the rivers in the south and west and a small trend to "early" for the rivers of Eastern Siberia were detected. The secular changes in the times of appearance of ice on these rivers reveal a regular pattern and are related to air temperature change in the monthly period preceding them. The most important statistically significant movements of these times to "later" occurred on the rivers of the European part of the country, on the Danube and on the rivers of Western Siberia. An evaluation of future changes in these times up to the year 2000 makes it possible to consider most probable their further shifting to "later" in the mentioned zones and a small movement toward "early" in Middle and Eastern Siberia. The transpiring and anticipated changes in the ice regime of rivers must be taken into account in hydrological computations and when developing methods for predicting ice phenomena. In synoptic-statistical prediction methods it is feasible to limit the database only to the last 30 years and it will be possible to use the proposed methods up to the beginning of the 21st century because anomalies close to those anticipated during that period were observed during individual periods during recent decades. The important features of changes in the ice regime of rivers in comparison with other elements of climate and the hydrological regime make it desirable that their investigation be included in a program for monitoring climate with the extension of this research to all freezing rivers of the world and all ice regime elements. Figures 2; references 20: Russian 14, Western 6.

**Environmental Pollution and Radiation Conditions in Russia in September 1992**

937N0066C Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 12, Dec 92 pp 111-112

[Article by A. M. Ovanesyants, N. A. Belova and M. N. Ivanov, Committee for Hydrometeorology and Environmental Monitoring; UDC 504.3.54—1992.09—(047)(47+57)]

[Abstract] During September 1992 extremely high pollution of atmospheric air was not observed anywhere in the country (as also was the case in September 1991), but high concentrations (greatly exceeding the maximum admissible levels) were observed four times in three

cities (Moscow (phenol and nitrogen dioxide), Volgograd and Solikamsk (hydrogen chloride)). Several oil spills occurred, but were of relatively minor importance. In that month five cases of extremely high pollution were observed in five water bodies (in the corresponding month in 1991 there were 21 cases in 14 water bodies). Extremely high pollution was observed in several rivers in Yekaterinburg Oblast caused by malfunctioning of communal facilities. In this same month there were 80 cases of high pollution in 59 water bodies, most clearly expressed in the Volga and its tributaries the Oka and Kama (39% of all cases of high pollution), the Ob and its tributary the Tobol (14%). Rivers in Murmansk Oblast were polluted to various degrees by nickel and copper. In September 1992 radiation conditions did not change substantially in comparison with August (the diurnal concentrations of radioactive aerosols and their fallout on the surface was at the background level). There was a single insignificant increase in radioactive fallout at Rostov-on-Don on 30 September due to meteorological conditions favoring accumulation of atmospheric impurities. Fires occurring over extensive areas during the summer of 1992 exerted no influence on radioecological conditions.

**Hydrogeological Analysis of the Consequences of Serious Accidents at Planned Nuclear Reactors.**

**Part 1. Basis for Predictive Models**

937N0071A Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 6, Nov-Dec 92 pp 92-102

[Article by V. G. Rumynin, P. K. Konosavskiy and S. A. Pereverzeva, St. Petersburg Mining Institute, under the rubric "Hydrogeology and Engineering Geology"; UDC 556.3]

[Abstract] Proposed improved techniques for modeling the groundwater effects of radioactive contamination accidents are based on computer modeling, laboratory research, and geological and geophysical field investigations. Three accident scenarios involving a VVER-1000 pressurized-water reactor are considered: 1) loss of coolant from a primary-loop main line, with the coolant condensing in the reactor building and filtering through the concrete foundation by means of either large cracks or diffusion; 2) a core meltdown with partial or complete penetration through the concrete foundation and contact between the molten core and the groundwater; and 3) a large atmospheric release of radioactive contaminants with subsequent fallout. Water-table contours, groundwater filtration rates, isotope migration rates, and reservoir-rock properties are given for the site of Phase III, Kola Nuclear Power Plant. The water-bearing rock is mainly fractured granite-gneisses or, in some low areas, marine sediments. The nonartesian groundwater is charged mainly by precipitation, and is very susceptible to technogenic contamination. The permeability of the fractured rock was determined by well-cluster tests. Radioisotope migration in groundwater was determined experimentally. Zones of maximum permeability 4-12 m

**Ecology**

thick were identified. The sorption of Sr90, Cs137, and Ce144 by core samples of granite-gneisses from beneath the reactor site was determined in the laboratory. The sorption test procedure, which differs from the standard procedure for porous rocks, is described. References 18: 15 Russian, 3 Western.

**Remote Determination of the Composition, Release Rate, and Temperature of Smoke Stack Emissions Using Raman Lidar**

937N0069 Tomsk *OPTIKA ATMOSFERY I OKEANA* in Russian Vol 5 No 7, Jul 92 pp 726-733

[Article by Yu. F. Arshinov, S. M. Bobrovnikov, V. K. Shumskiy, A. G. Popov, and I. B. Serikov, Institute of Atmospheric Optics, Siberian Division, Russian Academy of Sciences, Tomsk]

[Abstract] This article presents a detailed analysis of lidar sensing of emissions from the smoke stacks of factories. The effect of combination light scattering is used (Raman lidar). Measurement of the concentration of components has been refined using this method, and it has been shown that one can simultaneously measure the emission rate. The emission temperature can be determined from lidar signals from nitrogen molecules. Experimental results are presented from a Western Siberian metallurgical plant in Novokuznetsk. It is noted that this method can only be used for hot emissions. The method can be used to estimate the coefficient of attenuation of the emission, and from this one can draw information on the mass concentration of aerosol in the emission. Equations are presented which further refine the measurement technique. Figures 6; table 1; references 10: 2 Russian, 8 Western.

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